The American Biology Teacher

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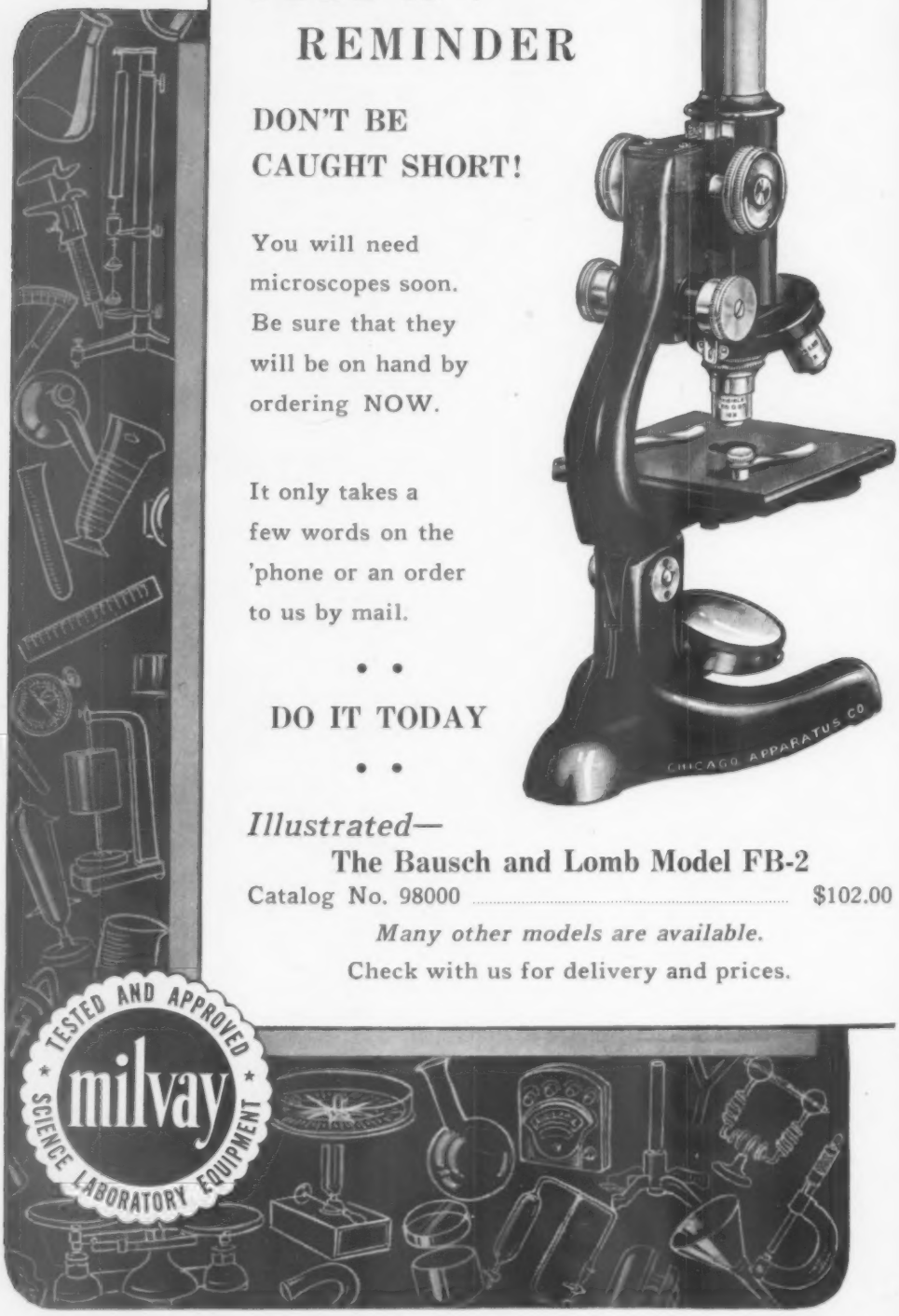

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The American Biology Teacher

Vol. 9 JANUARY, 1947 No. 4

Teaching Biology After the Wars

BENJAMIN C. GRUENBERG

Now that we have found out what an atomic-fission mechanism might do, what are we going to do with our science education? And specifically, what kind of biology are we going to teach next year or in the next decade?

Our education in the past has been tacitly based on the idea that the power which knowledge confers is primarily of value because it yields advantages in competition or in war. Can we continue to teach biology as if it were merely to increase the power of those who already have all the advantages?

Theoretically, everybody may benefit from the concrete or material results of scientific knowledge. Teachers and scientists, however, are but tardily discovering that people generally can *not* benefit from science unless virtually everybody has a chance to share in the social and spiritual consequences of scientific methods, knowledge, and attitudes. For in addition to the many possible applications of science there are many deep and far-reaching implications: science implies, for one thing, nothing less than universal democracy. Can we, after the wars, be satisfied to train technicians to "apply" science for those who hire them and at the same time disregard the implications of science for "everybody"? These are questions we have not been trained to face.

In 1932 the report, *A Program for Teaching Science*, more widely known as the "Thirty-First Yearbook" (of the NATIONAL SOCIETY FOR THE STUDY OF EDUCATION), formulated the goal of science teaching as "the enrichment of life through participation in a democratic way of life." The report does not define "democratic," perhaps because that is a political concept, not a scientific one, or perhaps because everybody knows what it means. Most of us, however, whether teachers or scientists, have received at best a smattering of Eighteenth Century "social philosophy"—just sufficient to make us good citizens for the way of life established by the colonists who rebelled against George III.

Because the schooling to which most of us were exposed was already highly departmentalized, we are inclined to assume that we can make science "prac-

tical" for everybody by teaching everybody the general concepts or principles of the several precious "subjects" and then pointing out some of the practical consequences. We show how discoveries about tubercles on the roots of leguminous plants can lower the price of cheese. We try to make our teaching practical by tying the germ theory in with personal or community routines in order to motivate a new ethic regarding public expectoration or regarding the acceptance of vaccination. We tie the life of the forest in with shortages of timber urgently needed for housing, or of paper pulp necessary for books and newspapers. And so we hope that eventually a new generation will arrive at a workable compromise between the moral right to exploit the world for private profit and the right of common people to preserve their material heritage.

Integration

In such ways we strive to achieve the "integration" that educators have been demanding of teachers who have been trained in various technical specialties. We introduce such categories as "conservation" or "health" or "plenty"—which have no place at all in the "pure" biology of the colleges. But we might apply in our teaching something about integration that we learned in our biology. We teach, for example, that the cell is "the unit of structure" in metaphytes and metazoa, although we long ago gave up the idea that the organism grows by adding cells to piles of earlier cells. We think of the organism as being continuously a whole organism, from its one-celled stage on, and as being continuously engaged in "integrating" the progressively differentiating parts. Why must we, when we are teaching, act as if we considered the somites of an arthropod larva, for example, or the polyps of a hydroid colony, to be independent units that somehow get stuck together and become differentiated and then "integrated" into a unified living being? The coherence which we observe in the behavior of the insect has been there from the beginning: it is not the result of a final act of "integration."

In teaching biology, we have to recognize that the student, with his attitudes, tastes, appreciations, hopes, and fears, is an organic whole—which includes his systems of ideas. We cannot, of course, relate our teaching to all his needs and interests simultaneously. But we do not have to arrange our topics according to the categories which research biologists have developed for organizing their technical material. We can cut our material of instruction into units that are more directly related to the daily affairs of people, the common problems, the common curiosities, the common concerns—which are already familiar to children. Every child is concerned with food; but it is a rare child who wants to know about nutrition and assimilation. Many children will wonder how the "good" part of the meat or milk or molasses came to be, but hardly any will inquire into the meaning of "photosynthesis." Every child will ask where babies come from, but few are likely to ask about the "principles of reproduction."

We must of course try to familiarize students with the "big ideas" or principles, but we must from the first teach these in relation to common problems. We educate and we become "scientific" when we pool common experiences or traditions that bear upon such problems; for then we discover how inadequate our common ignorance is and how incongruous are our diversified answers. We discover how complex the common everyday problem is, and proceed to analyze it; and then we consider the possibility of

solving one fraction at a time. At this stage we may help students to realize that biology is part of everybody's business, rather than the secret preoccupation of remote scientists pursuing private curiosities. Our students must learn that *we are all biologists*, whether we know it or not, for everybody has to develop a theory of life and "apply" his theories to everyday living.

Methods

To develop general scientific concepts by attending to common problems, we have to give special consideration to methods. As the Report of the Harvard Committee points out, "science instruction in general education should be characterized mainly by broad integrative elements."[1] This does not mean special "lessons" for integrating but something in our methods that does affectively and significantly tie together.

We tie together by comparing: we compare the scientific method with other methods that any of us may know—hearsay or folklore, authoritative tradition, uncritical empiricism or "depending on experience," argumentation, hunches or revelations, "superstitious" beliefs. We compare the methods of biologists with those of physicists and astronomers, with those of historians or lawyers. How did people in foreign lands or in former times solve these same problems? We tie together by bringing out relationships—what depends on a sound solution of this problem? Who would be affected by it favorably—and who unfavorably? We tie together by relating the problems and the methods to the social conditions in which they arise. The Crusades and other great migrations distributed loot and learning as well as plagues and prejudices; and they created new problems for those who remained at home; the work of Leeuwenhoek had to precede the germ theory, but the evil-spirit theory did not have to wait for microscopes. And we tie together by showing how contributions to our understanding came from many nations, many cultures, many races and sects.

Such integration means, of course, that the teacher and the students must constantly go out of bounds; but all genuine effort to understand must always do that. Our own specialty involves not only geography and geology, physics and chemistry, astronomy and mineralogy, but economics and public policy as well as glass-blowing and refrigeration.

Teachers who feel under pressure to cover the vast and constantly growing bodies of special knowledge will be tempted to use spoken and printed words where they should use demonstrations, and to use demonstrations where they should help students with direct laboratory and field experience. For laboratory work and direct observations take time. And trying to report clearly and precisely what one has experienced and thought takes much effort as well as time. But students can achieve the desired understandings *only* through direct handling of materials and situations so as to yield conclusions which leave no doubt, even though they raise new questions. Teaching by merely *telling*—however emphatically—the many facts, the great conclusions, the "steps" in scientific procedures, the social or economic implications of great discoveries, defeats the very purpose of our science. To cite the Harvard report again, whatever may be conveyed without precision and without relation to direct observation "is not only not science, but it in a very real sense unscientific" (*ibid.*, p. 153). The Report continues,

[1] *General Education in a Free Society.* Report of the Harvard Committee. Harvard University Press, 1945. p. 155.

"It comes perilously close in spirit to the scholasticism with which modern science broke at its inception. It possesses the typically scholastic reliance upon verbal authority—in this case the authority of the writer of scientific texts—it has the same predominantly deductive logical structure, and the same preoccupation with words rather than with objects and processes which they only imperfectly symbolize. The thought that an understanding of science might be conveyed as well or better without direct observation, experiment and mathematical reasoning involves a fundamental misapprehension of the nature of science."

Science is today the most dynamic agency for bringing the minds of men together. People everywhere are sundered and antagonized by their conflicting bigotries, their conceptions of virtue and worth, even by their criteria of beauty. But in science they can all reach common agreements. We need not urge that scientific principles carry a higher degree of validity than political principles. Nor need we belittle philosophies or religions or "superstitions" because every tribe and every age has had its own exclusive brand. But it does seem significant enough for everybody to understand that what we call our present body of scientific principles includes contributions from all peoples; that it is both being used and continuously enlarged and refined by people of all nations, races, religious views; and that it is continuously being validated and re-appraised by *methods that are equally available to all people*, regardless of race, nationality, or political or religious faith. The last claim has, of course, its limitations; for some people will refuse to look through a microscope or into the inside of a living animal by means of X-rays. There are still those who know the answers in advance and will not be moved by scientific methods of inquiry. Science is nevertheless mankind's first systematic attempt to attain a clear and workable grasp on reality that has no secrets to hide and that excludes nobody.

At this moment in history, when delegations from nearly all nations are meeting to find a basis for keeping the human race from destroying itself, the only groups that are able to agree are not the professional diplomats, not the religious leaders, not the orators and writers and scholars trained in history and the "humanities." It is the scientists alone who speak an international language and can agree on principles that affect our very existence. At the same time, scientists have generally, until recently, been either indifferent to what professional managers and leaders have been doing through politics or social criticism, or else quite lacking in strong convictions as to what kind of society science implies—nay, demands. Since the puffs of smoke blew away from Hiroshima and Nagasaki, some of us have come to suspect that the recommendations of scientists who are quite ignorant of the classic traditions could hardly be worse than the multiplicity of irreconcilable counsel to which we have been subjected.

The best we shall be able to do with our biology teaching may not end war—soon. But it may do much toward enlarging the areas of mutual understanding and mutual consideration. It might re-orient that self-assurance, not to say conceit, from which people generously try to be "tolerant" toward others. It might at least bring many more to heed Cromwell's pleas to his captains, when he said, "I beseech you, my brethren in the bowels of Christ, consider—you may be mistaken."

At the Boston meeting of the Editorial Board, Robert C. McCafferty, Wadsworth, Ohio, was selected as a member of the editorial staff. He has been active in the association for many years and has contributed "Two Problems of a Hydrophytic Habitat," "A Show-case Display," and "Practical Suggestions for Field Activity" to *The American Biology Teacher*.

Term Papers or Term Projects in Biology?

CHARLES W. QUAINTANCE
Eastern Oregon College of Education, La Grande, Oregon

In a large university a certain scientist tells how he was cured of assigning term papers to his freshman biology classes. One spring the students blithely handed in their more or less voluminous term papers but were later surprised when they came to the final examination. There was but one question handed to them: "Write your term paper." Many students could not begin to do this, since they had not made the new knowledge a part of themselves. Such incidents cause the conscientious biology teacher to question the value of library term papers.

For six years, in an effort to make freshman student research a more vital experience, Eastern Oregon College has used biology term projects instead of term papers. An explanation of the system used and its possible values is presented to interest others in considering a similar program. It should be noted that while a college experience is reported here, this procedure may be adapted to high school biology classes also.

Examples of Term Projects

As the name, *term project* implies, there is a distinction between a small project for a daily assignment, and that expected for a term assignment. A daily project might be illustrated with the assignment: "Collect the longest one-year twig you can locate, and the oldest six-inch twig you can find." For term projects at college level, collection-type projects are discouraged. Someone has said that collections alone make museums, and not naturalists. The collection of leaves, twigs, and flowers has its place, but it does not answer the objectives of a term project at college level.

An annotated term project which serves also as an example suitable for teacher-training students follows: "Make an underwater zoo. (Cf. McClintock, *The Underwater Zoo*) (a) To make balanced aquaria, plant *Elodea* in containers of different sizes. Use a large aquarium and several others of gallon or less capacity. (b) Stock large aquarium with varied aquatic life from local ponds, replenishing from time to time. (c) Isolate in separate smaller aquaria such voracious forms as the Giant Water Bug. (d) Observe at different times of the day and evening. Make appropriate notes and drawings on feeding habits, modes of breathing, metamorphosis, and other behavior of the underwater animals therein."

An example of a pre-medical project would be: "(a) Quick-freeze and slice a fetal pig, the arteries and veins of which have been previously injected with a synthetic colored latex. For the exhibit days, mount slices in consecutive order, to demonstrate continuity of organs. (b) From slaughter house obtain fetuses within the uterine horns; demonstrate these to classes."

Wild pets make popular projects. Securing the "pet" is often the most arduous and time-consuming part of the project. The laboratory during project season has as many of these native live animals as space permits. Representative animals brought in are: ground squirrels, muskrat, coyote, porcupine, deer mice, chipmunks, painted turtle, spiders, salamanders, and snakes, and interesting insects such as the praying mantis.

The birth of young and their survival under the abnormal conditions of the

laboratory, crowded during the day with moving humans, is keenly followed by the students. One instance will suffice to illustrate the enthusiasm aroused. A college girl "drowned out" a ground squirrel from its burrow on the greasewood plains. Shortly naked young were noted in the cage, thus establishing the sex of the wild little captive. Two, three, five, and finally, seven young appeared. The interest of the college girl became almost maternal, especially after the mother appeared to have eaten two of its young. The owner of the project threw a wrap over the cage to darken it, and the other five young, were raised successfully. A touch of college humor was injected one night at the girls dining room when the possessor of the ground squirrel progeny was saluted with a song of congratulations.

The experimental project has popular appeal and learning value. For example, "(a) Feed experimental hamsters a diet deficient in calcium; keep controls on a normal calcium diet. (b) Weigh regularly, and plot graphs on weights of each individual hamster, both experimental and control. (c) Skeletonize one each of the control and the experimental groups. Mount bones of these two side by side, for comparison." On such a project, two persons, congenial to each other, elect to work together, and are each responsible for alternate days, including the week-ends.

Some projects are difficult to exhibit satisfactorily, yet have real value for certain types of students. An example of this kind of project is the observation of nesting, courtship, and feeding of a species of bird. One spring at the college, one of the best athletes chose to pursue the wanderings of a partially albino robin. He followed the bird through two nestings, on or near the campus, and while an inheritance of white feathers was not shown, the project served to keep the class aware of the presence of a fine example of mutation.

Procedure for Term Projects

A list of suggested projects is prepared; each project is annotated with suggested procedures, such as the examples just given. Instructors will develop favorite project sources, such as the files of *The American Biology Teacher* and of *Turtox News*. Students, from time to time, originate new and popular projects. The project list is made as extensive as possible in order that there will be enough for all students without necessity of duplication. Besides, an extensive and varied list of projects gives the individual student a chance to find something he would really enjoy doing.

Student initiative is encouraged. Each student chooses his own projects, and is responsible for carrying it through with as little help as possible. Some students may require more guidance than others, however, but the instructor refrains from giving too much help. By the spring quarter when projects are in full swing, the instructors are more or less familiar with the adaptability of each student for project work, and consequently can give helpful counsel in student choice and also in carrying the project to completion.

Students Also Grade Projects

With the aid of a pre-rating students can satisfactorily rate projects. It has become traditional for the instructors to appoint a committee of from five to seven students of both sexes, and from both dormitories and town, the committee to be responsible for evaluation of all projects. Criteria for student grading are established.

As a motivation for students a project exhibit is set up as a culminating activ-

ity. The date for completion of projects is set for several weeks before finals in order not to compete with the final term requirements of other courses. The date for completion of projects automatically sets the date for the Project Exhibit.

Term-Project Exhibit

School children of the city schools are invited as guests of the college biology department at scheduled times during Exhibit Days. They are accompanied by their teacher who has prepared them somewhat for the biology "circus." Many teachers require the school children to take notes on what to look for, and then what they actually observe. This culminating activity is organized through student chairmen who arrange for biology students to act as guides at each scheduled hour. The reactions of school children, the questions they ask, and the interest of the grade school teachers, all repay the college student for time spent acting as guide. Many non-biology students of the college, high school students, and citizens of the community attend the exhibit. This year a total of some thirteen hundred school children attended. In addition, the exhibit was held over for the customary Mother's Day Week End when mothers from this region visited the college.

The local newspaper sent up a reporter who headlined his article "Tots see chick heart beat." One fourth-grader was able to guess the name of a black-skinned mammal stuffed by one of the students. She was the only one of a group of thirty who touched the skin, felt the spines, and guessed a baby porcupine. Thus she won a nickel. A few minutes later, up at the drinking fountain, she confided to the instructor, "I didn't like science before, but now I am going to be a scientist."

These anecdotes illustrate that the exhibit of good projects has dramatic value for college students, for children and for adult citizens of the community. It gives grade school and high school teachers ideas, too. Thus, the value of term projects goes beyond the classroom. Certainly in communities where there is no college, the local high school can follow out a somewhat similar procedure. In teachers colleges biology may be professionalized in this way.

Evaluation of Project Teaching

A valid objection to term projects instead of term papers is that projects do not give the student an opportunity to write and organize his thinking and to apply what he learns in Freshman English. The student does miss a chance to write an extensive, documented paper, it is true. However, freshmen term papers are often written with large passages copied verbatim from books, without adequate acknowledgment. Some papers are digests of others on file in the dormitories. Besides, the biology student has had a chance to do some writing earlier with regard to required book reports on natural history.

On the other hand, a good term project does require organization, and often, some writing up of results. The distinction between project work and library work is that the student learns from what he does rather than what he reads only. As indicated in the introduction to this paper, the *term project* is intended to vitalize a *learning* experience. If it fulfills this need it may be relatively unimportant whether the writing of a long paper is called for or not.

Term projects are not easy to grade, and some may object to student grading. Both term papers and term projects are open to the same criticism, namely that they can be rated, at best, somewhat subjectively. However, the average of student grading by members of a student

committee agrees, on the whole, with grades written down beforehand by the instructor, and students know often better than the instructor who has done meritorious work.

It is difficult to measure the learning students get from the term project. Nevertheless, the total class learning may be considerable, since all students are exposed to the projects that daily evolve before their eyes. In addition, students learn much from projects which they present to visitors during Exhibit Days.

The writer believes that most students like the term project idea. It furnishes a change of pace in a busy reading program. Some students, however, and possibly these are the ones who are inclined to be lazy, may not be able to settle themselves into project work, where they have to make some of the decisions. For example, some do not have the patience to sit down at the workings of a pocket gopher and watch its behavior, even though they have chosen the project. What these same students would do with library papers is problematical.

From the standpoint of the instructors, two serious objections are those of lack of time and lack of space. When individual projects from a class of some two hundred biology students are gathered into a classroom, around the walls and on the laboratory tables, the place is crowded. It becomes a project for the instructors themselves to meet this serious problem. Also, animal projects naturally add strange smells to the room. If separate rooms are available for project exhibits, this is highly desirable. Projects do demand more of the instructors' time, although after several years the card file of projects and the traditions built up, will tend to lessen the load here. There is much more student conference with the instructors in this type of work than there would be, for example, with term papers.

Summary

Each year one is tempted to revert to the easier method. Nevertheless, the fact that new students early each year make inquiries about their proposed project indicates the advantage inherent in student interest. There is much to be said in favor of the term project system.

Term projects follow the psychological dictum of learning by doing. Projects enrich traditional book study.

Non-academic students have a chance to display their ability. It will be conceded that some of the most conscientious students have difficulty in book learning, but by dogged persistence at a project they may solve problems where the brilliant student might give up. Also, a diversified term project program provides for professionalization of the biology course. Moreover, projects lead to interesting hobbies, which in some cases become the life work of the student.

Although it should not be a major objective of the term project program, the instructor may benefit indirectly where desirable biology exhibits ordinarily found in the classroom are excellently cared for by students.

Total class learning is considerable where term projects are used instead of term papers. The incident of the ground squirrel and its young were a concern of every biology student, as well as of many outsiders who visited the laboratory.

As indicated previously, term projects and their presentation to the class and to the community in exhibits possess exceptional dramatic value. Besides they are educational for teachers and students who visit the Exhibit from the lower grades.

The *Large-flowered Trillium*, which changes from white to pink, grows rapidly from seed in garden. Photo by C. R. Shoemaker.

Conservation Series, Unit VI

The Introduction of Natural Resource Planning into Our Schools of Today

RICHARD L. WEAVER
Educational Director, Audubon Nature Center, Greenwich, Connecticut

The metamorphosis of our nature teaching in the schools from an elective, esthetic, and extra-curricular activity to a dynamic required curriculum MUST has been taking place over the last ten years in a slow but determined way. Soon we shall see natural resource planning emerge in our natural and social science programs as one of the dominant and important interests which will influence many other fields such as art, writing, literature, sociology, history and government.

In states and cities where conservationists have approached school administrators with a sound practical approach to resource planning, programs have been introduced and conducted with surprising success. Whether these programs be called nature study, nature education, conservation education, or natural resource planning, they all must embody the fundamental concepts of conservation if they are to succeed and win the support from school people, who are already besieged by hundreds of new

Gardens are of interest to boys and girls alike, in all grades of the elementary school. Cleveland School Garden Photo.

interests and in some cases by selfish groups.

One of the first tenets of a sound conservation program is that it be inclusive enough to encompass interests of the majority of the people. It will not be readily accepted if it caters to any special interest group. It can, however, include portions of many of the programs sponsored by these special groups.

Conservation is unselfish in its requirements, and yet it is often sponsored by groups that are selfish, biased, or narrow. In so many cases it has emerged as a crusade of groups or individuals formerly engaged in destructive practices and which have become conscience stricken or felt the pinch of dwindling resources and saw conservation as their only salvation. In a few cases it has been a fine vehicle for otherwise obscure individuals to ride to fame. Certainly more people have become attracted to it by what they could give than what they would receive in remuneration. Too often what has been "sauce for the goose failed to be sauce for the gander," and what was preached failed to be practiced.

We must undertake conservation of our natural resources for the sake of the resources and for the majority of the people, and we must use the selfish interests of groups and individuals only insofar as it does not endanger the main cause.

A second tenet is that the conservation education program be important and practical. It must remain within the possibility of execution within the schools. Administrators and teachers alike are reluctant to accept additions to their programs unless a definite need is felt and they can see how it can be incorporated into their already crowded program.

The school garden offers a fine opportunity to bring good conservation practices to the attention of the younger pupils. Cleveland School Garden Photo.

How to Plan Conservation Projects

This is not too difficult if we begin with local problems and apply the same procedures that are used in solving similar problems in other fields. If the community needs tennis courts, a swimming pool, a recreation center, a new school, or a more efficient fire or police system, an interested group or an individual must first arouse interest in the project and demonstrate the need. Information concerning the probable use, and such items as the cost, and desirable location, must be obtained. This must be submitted to those in charge with a definite proposal or list of suggestions. Far-

Planting seedlings and sloping gully sides. For certain types of activities it may be necessary to divide the class into sections and take the groups out at different times.

sighted administrators usually have some plans formulated already and welcome lay support. So with the cooperation of the responsible officials, the majority of the people must be convinced of the importance of the project and must give an affirmative vote to authorize the cost.

Teachers should not let such opportunities pass by without student consideration of them. These projects, while not school sponsored, offer a challenge to any teacher to engage in some real constructive and worthwhile teaching. Conservation problems and projects offer as many opportunities for making teaching a living experience.

Here are some of the possibilities in the conservation field:

An adequate park system with nature trails, wildflower gardens, wildlife shelters and feeders, picnic areas, and hiking trails.

A town or school forest to demonstrate practical forestry methods and have a supply of lumber, Christmas trees, and fuel for the school.

A well-landscaped school yard which is attractive to birds and mammals for close observation.

A living nature museum, zoological or botanical garden to demonstrate proper care of plants and animals.

Attractive approaches to the town or city by auto and train where advertising is properly planned for the best appearance, and wildlife habitats are considered.

Wildlife sanctuaries with plants, birds, mammals, snakes, predators living together in their natural state.

Streams managed so as to be desirable places for plants, fish, birds, and bathers.

Fields tilled to keep the topsoil in place and in a fertile condition.

Lakes, seashores, and forests clean and available to the public and properly supervised.

Forests that are cut on a sustained yield basis.

Marine and aquatic resources harvested on a sustained yield basis.

Coal and oil mined and utilized efficiently.

Land generally utilized to its best advantage for stream and erosion control, forest or game production, for recreational or agricultural use.

A field study of erosion.

What town or city can say "We do not need natural resource planning" if confronted with a list of problems and possibilities such as that? What school administrator can dare say "That is not within our province?"

Just where do these things fit into our educational program, are they science,

Eight-year-olds look at their world.

civics, sociology, history, geography, biology, or community problems? No one of these subjects can encompass them all or provide the information required for a full understanding of the problems involved. ALL of these subjects have a direct bearing on them. Students must learn from their histories of our bountiful past and of our extravagant use and exploitation of our resources. From their science and biology they must know the nature of these resources, their present abundance or scarcity, and from their social sciences they must encounter the social barriers, the expense of counteracting self-interests, and the cost of resource planning, as well as the difficulties of administering the programs and of getting the people to use the resources and facilities wisely once provided.

Elementary school children must be introduced to these resources in an interesting way. They need not become too involved in the problems surrounding many of them, as this phase can be reserved for junior high or for high school and college. The younger children must be taught to enjoy and respect the resources around them and this in itself is a real challenge for the first six or eight grades.

In high school and college these wholesome interests must be channelled into constructive projects where the students can feel the need for group and community action and support. They must begin to feel their places as citizens who will use these resources and be cheated if they or their children find the resources squandered, depleted, endangered, or unobtainable.

Through the schools we must interest the parents, the town fathers, and the citizens of the future in seeing that the community, the county, the state, the nation, and even the world is a healthy, prosperous, and a desirable place in which to live and to raise future generations of citizens.

Source Materials in Conservation

One of the barriers frequently cited to getting more teachers and adminis-

trators to sponsor conservation education programs has been the dearth of suitable texts and source materials.

However, as conservation education and resource planning have been gaining recognition, particularly during the last ten years, some states and numerous organizations and federal agencies have prepared guides, informational and curriculum bulletins for use in the schools.

These materials should aid considerably any teacher or school system interested in promoting a conservation program.

Year around state programs in conservation education have been prepared in Colorado, Georgia, Indiana, Kentucky, Michigan, Missouri, Ohio, Tennessee, West Virginia, Virginia, and Wisconsin; through the Department of Education or Public Instruction. New Jersey and New Hampshire, Massachusetts, Virginia, Washington, California, and several other states have specialized in conservation week programs.

In Kentucky, Michigan, Ohio, Tennessee, and West Virgina, the departments of conservation co-sponsored the preparation of the curriculum materials and aided financially through underwriting a part of all of the salaries of the specialists or supervisors who organized the program. In Missouri and Pennsylvania the conservation education efforts have been largely concentrated in the department of conservation or game commission. In Iowa, New York, and New Jersey the state colleges or universities have supplied most of the informational bulletins although the departments of education have been interested and cooperative.

The more recent and available publications from the states are listed in Part I of the accompanying materials list—Source Materials from States.

The Federal agencies which have prepared special conservation materials for school and club use are: U. S. Office of Education, The Soil Conservation Service, U. S. Forest Service, and the U. S. Extension Service. Many of the resource bulletins by the U. S. Fish and Wildlife Service are also valuable for school use. The National Audubon Society, Garden Club of America, and National Wildlife Federation have prepared excellent guides, informational bulletins, and pictures. Guides for teachers giving sources of information and materials have been included in the *Journal of Geography, American Biology Teacher, American Nature Association Quarterly, Nature Magazine,* and *Audubon Magazine.* Some of these materials are listed in Part II—Source Materials from Federal and National Agencies.

Part I

Source Materials from States in Conservation Education and Resource Planning

California

Department of Education, Sacramento
The Science Guide bulletins
1. Land Farms—February 1937 (Out of print)
2. Water, Its Conservation and Use—March 1937 (Out of print)
3. Soil, Its Use and Conservation—September 1938 (Out of print)
4. Insects, $1.45
5. Birds, 25¢
6. Frogs and Toads, 25¢
7. Animal Studies, $1.50.

Source Material for Conservation Week Bulletin No. 1, 56 pp., 1936

Colorado

Department of Education
1. Conservation of Natural Resources, 136 pp.

Georgia

State Department of Education
1. Natural Resources of Georgia, 222 pp., 1937

Illinois

Illinois State Museum, Springfield
1. Illinois Mammals, Today and Yesterday, 40 pp., 15¢

2. Birds in Your Backyard, 240 pp., 1941, 60¢

Indiana

Department of Public Instruction, Indianapolis
1. Conservation of Soils
2. Conservation of Water, 48 pp., 1946
3. Conservation of Plants (In preparation)
4. Conservation of Wildlife (In preparation)
5. Conservation of Fishes (In preparation)

Iowa

Iowa Extension Service Ames, Iowa
1. Native Ferns of Iowa, Extension Circular 225, 52 pp., June 1936
2. Upland Game Birds of Iowa, Extension Circular 228, 32 pp., June 1936
3. Some Common Iowa Fishes, Extension Circular 225, 32 pp., June 1936
4. Winter Birds Around My Home, Extension Circular 241, 32 pp., September 1937
5. Nesting Birds of Iowa, Extension Circular 247, 64 pp., March 1938
6. Fur Bearers and Game Mammals of Iowa, Bulletin P3, 32 pp., February 1940

Kansas

State Teachers College, Emporia; Loren W. Mentzer, Wildlife Conservation

Kentucky

Department of Education, Frankfort, Kentucky
1. Units in Conservation of Wildlife and Other Natural Resources, 275 pp., August 1941

Michigan

Department of Public Instruction, Lansing
1. Learning to Conserve Natural Resources, Bulletin #322, 82 pp., 1942, 25¢
2. Conservation Education in Michigan, Bulletin #3020, 25¢

Department of Conservation, Lansing
1. Wildflowers of Michigan, 5¢
2. Common Trees of Michigan, 10¢
3. Michigan Rocks and Minerals, 25¢

Missouri

Missouri Conservation Commission, Jefferson City
1. Conservation, Introduction, Vol. 1, 30 pp., 1940.
2. Conservation, Soils, Vol. II, 32 pp., 1940
3. Conservation, Water, Vol. III, 28 pp., 1941
4. Conservation, Forestry, Vol. IV, 34 pp., 1941
5. Conservation, Birds, Vol. V, 30 pp., 1941
6. Conservation, Mammals, Vol. VI, 30 pp., 1941

University of Missouri
1. Wildflowers of Missouri, Circular 363, 1937

New Jersey

Agricultural Experiment Station, New Brunswick
1. Birds of New Jersey, 1928–1941 Bulletin Numbers 439, 470, 520, 531, 544, 553, 602 618, 640, 678, 690. (Birds grouped by families)

Department of Public Instruction, Trenton
Conservation Week in the Schools of New Jersey
1. The Preservation of Native Plants, 16 pp., 1937
2. Defend New Jersey Soil, 16 pp., 1942
3. Other Annual Bulletins

New York

Department of Rural Education, Cornell University, Ithaca
Cornell Rural School Leaflets, 32 pp., 50¢ per year, 4 numbers per year.
1. Conservation, January 1936
2. Save the Soil, March 1936
3. Are They Vermin, November 1937
4. Nature Bibliography, September 1938
5. Farm Forest Facts, November 1939
6. Fields in Winter, January 1940
7. Waterways in Spring, March 1940
8. Holes in the Ground, November 1941
9. Conservation Cartoons, September 1942
10. Wild Foods, March 1943
11. Cover, March 1945
12. Outdoor Laboratories
13. Hedgerows, November 1946
14. Amphibia, March 1947
15. Many other Nature numbers

New Hampshire

State Board of Education, Concord
1. Conservation Week in the Schools of New Hampshire
2. Annual Bulletins

Ohio

Department of Education
1. The Teacher Looks at Conservation, 64 pp., 1940
2. Conservation for Tomorrow's America, 144 pp., 1942, 50¢

Pennsylvania

Pennsylvania Game Commission, Harrisburg
1. An Introduction to the Mammals of Pennsylvania, Bulletin 15, 10¢

2. Pennsylvania Bird-Life, Bulletin No. 17, 68 pp., 1938, 10¢
3. Pennsylvania Wildlife, Bulletin No. 18, 48 pp., 1938, 25¢.
4. More Food for Upland Game, Bulletin No. 11, 44 pp., Free
5. Wildlife in the Farm Program, Bulletin No. 16, Free
6. Special Wildlife Refuge Projects, Free
7. A Game Restoration Job for Everyone, Free

Tennessee

Department of Conservation, Nashville
1. Tennessee Wildlife, Bulletin No. 4, 43 pp., 1938, 20¢
2. The Natural Resources of Tennessee, 80 pp., 1939
3. Taking Conservation to the Schools, Bulletin No. 9, 1943
4. Wildlife Conservation in Tennessee, 18 pp., mimeo.
5. Birds of Tennessee in Verse and Story, 64 pp., 20¢
6. A Guide to the Fishes of Tennessee, 124 pp., 30¢
7. Forest Facts and Forest Trees of Tennessee, 64 pp., 5¢
8. Conservation Workbook for Women, 27 pp.

West Virginia

Department of Education, Charleston
1. Units in Conservation for West Virginia Public Schools, Vol. I, Elementary Grades 1–8, 120 pp., April 1939, 50¢
2. Units in Conservation for West Virginia Public Schools, Vol. II, Secondary Grades 7–12, 128 pp., April 1939, 50¢

Wisconsin

Department of Public Instruction, Madison
1. Teaching Conservation in Wisconsin Schools, Curr. Bull., Vol. I, No. 1, 72 pp., 1937
2. Helps in Teaching Conservation in Wisconsin Schools, Curr. Bull., Vol. I, No. 2, 102 pp., 1938
3. Helps in Planning Conservation Learning Experiences, Curr. Bull., Vol. I, No. 3, 58 pp., 1943

Department of Conservation, Madison
1. Programs and Projects for Junior Conservation Clubs, 28 pp., September 1942
2. Wisconsin Wild Flowers
3. Wisconsin Wild Life—Birds
4. Wisconsin Game Fish

Wisconsin Conservation League, Horicon
1. Conservation for Wisconsin Schools, The Soil, 36 pp., 1942
2. The Forests

Part II

Source Materials from Federal and National Agencies in Conservation Education and Resource Planning

The American Biology Teacher, 403 California Ave., Royal Oak, Michigan, $2.00 one year (monthly through the school year)

Conservation Series
1. Unit I, Seven Keys to Wildlife Conservation, December 1943
2. Unit II, Our Nation's Health Lies in the Soil, March 1944
3. Unit III, Conservation of Fishes, April 1944
4. Unit IV, Biology and Soils, May 1944
5. Unit V, Wild Flower Conservation, April 1945

Special Issue on Conservation, January 1943

American Nature Association, 1214 16th Street, Washington, D. C.

Quarterly Bulletin
1. Teaching Conservation, 32 pp., 25¢
2. Problems of Conservation, 32 pp., 1938, 25¢
3. Conservation Education Problems in Schools, 32 pp., 1938, 25¢

The Garden Club of America, 598 Madison Avenue, New York, N. Y.
1. Conservation Guide, 46 pp. (out of print)

Journal of Geography Magazine, 3333 Elston Ave., Chicago, Illinois, $2.75 one year, 35¢ single copy

Six issues with Conservation Education emphasis
1. November 1942—Pictures, charts and posters
2. December 1942—Slides
3. January 1943—Film strips
4. February 1943—Objects, specimens, models
5. March 1943—Maps
6. April 1943—Motion pictures

National Audubon Society, 1006 Fifth Avenue, New York, N. Y.

Educational Leaflets

1. Bird Study for Camps, No. 21
2. Bird Houses, No. 29
3. Bird Day, No. 30
4. Electric Nature Games, No. 34
5. An Owl Study Program
6. How Should Nature Be Taught, No. 35
7. Soil—How Wildlife Depends Upon It, No. 36
8. Water—Life Blood of the Earth, No. 37
9. Swamps and Marshes, No. 38
10. Forests, No. 39
11. Grasslands, No. 40
12. Nature Trails
13. Small Nature Museums
14. Building a Nature Interest
15. Nature Photography

Teachers Guide—A Source Book for Advisors of Audubon Junior Clubs, 92 pp., 1944, $1.00

School Nature League Bulletins, 10 issues per year, $1.00. Many nature subjects

National Education Association, Department of Rural Education, Washington, D. C.

1. Conservation Education in Rural Schools, 1943 yearbook, 50¢

National Wildlife Federation, Washington, D. C.

My Land and Your Land Conservation Series

1. Would You Like to Have Lived When? Grades 3, 4 and 5, 32 pp., 1941
2. Raindrops and Muddy Rivers, Grades 4, 5 and 6, 32 pp., 1941
3. Plants and Animals Live Together, Grades 5, 6 and 7, 48 pp., 1942
4. Nature's Bank—the Soil, Grades 6, 7 and 8, 48 pp., 1942

United States Office of Education, Washington, D. C.

1. Conservation in the Education Program, Bull. No. 4, 78 pp., 1937
2. Teaching Conservation in Elementary Schools, Bull. No. 14, 125 pp., 1938
3. Conservation Excursions, Bull. No. 13, 106 pp., 1939, 15¢
4. Curriculum Content in Conservation for Elementary Schools, Bull. No. 14, 80 pp., 1939
5. Opportunities for the Preparation of Teachers in Conservation Education, Pamphlet No. 90, 20 pp., 1941
6. Conservation Films in Elementary Schools, Bulletin No. 4, 38 pp., 1941
7. Choose a Book About Things to Be Conserved, Leaflet No. 60, 20 pp., 1941
8. Conservation Bibliographies, Good References series, Nos. 55, 70, 71, 72
9. Conserving Farm Lands, Vocational Division Bull. No. 201, 104 pp., 1939

U. S. Extension Service, Washington, D. C.

1. Teaching Conservation of Wildlife Through 4-H Clubs, 34 pp., 1938, 10¢ (U. S. Gov't Printing Office)
2. Forestry for 4-H Clubs, 50 pp., 1941, 10¢ (U. S. Gov't Printing Office)

U. S. Forest Service, Washington, D. C.

1. Forest Conservation—Packet (Selected Publications of the Forest Service for Schools and Libraries—U. S. Gov't Printing Office)
2. Conservation Workshops—Regional Office, Phila., Pa.

U. S. Soil Conservation Service, Region 1, Upper Darby, Pa.

1. Teaching Materials in Soil Science for General Science, Biology, Physics and Chemistry classes, 11 pp., mimeo, Free
2. Getting Acquainted with the Soil, 13 pp., mimeo, Free
3. Outline Soil Erosion, Soil Conservation and Water Conservation, 12 pp., mimeo, Free
4. Soil Conservation and the Public Schools, 5 pp., mimeo, Free
5. Bibliography, 3 pp.
6. Film sources, 2 pp.
7. Some References for Teachers on Soil Conservation and Land Use, Division of Information SCS B-2, March 1940 (4147), 8 pp., mimeo., Free
8. Numerous other publications and bibliographies available upon request

EDITOR'S NOTE: This is a renewal of a series of units started two years ago by the conservation committee under the leadership of Chairman E. Laurence Palmer. The previous units were:

I. *Seven Keys to Wildlife Conservation*, E. Laurence Palmer.

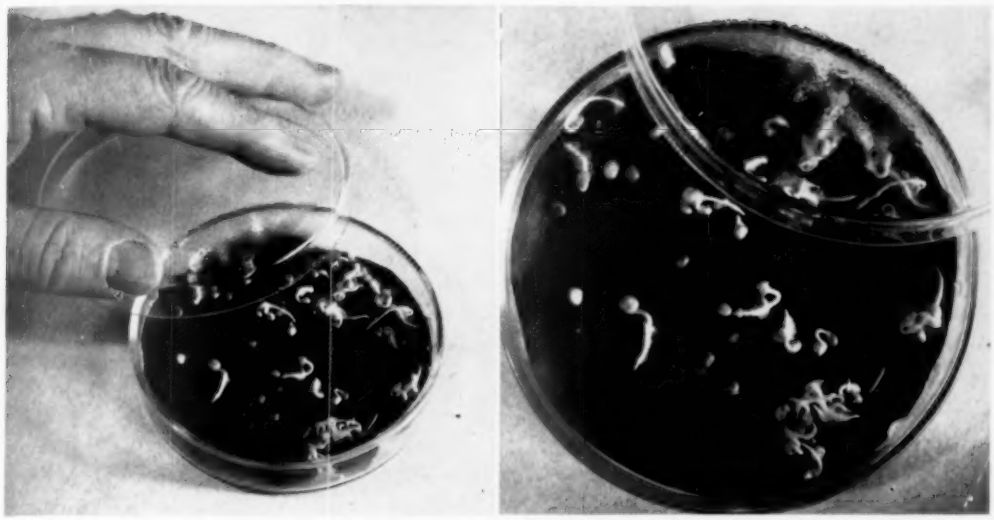
II. *Our Nation's Health Lies in the Soil*, Ollie E. Fink.

III. *Conservation of Fishes*, Howard H. Michaud.

IV. *Biology and the Soils*, F. Olin Capps.

V. *Wild Flower Conservation*, P. L. Ricker.

All of these have been placed in the middle of the magazine in 8-page sections which may be removed without disturbing the remainder of the contents. Units dealing with insects and with vertebrates are tentatively under way. Suggestions for future units or for authors and organizations who might contribute future units are in order.



LABORATORY AIDS

To Show Root Hairs

To show beginning biologists how root hairs really look it is only necessary to line the bottom of a Petri dish with two layers of paper towel, a top layer of black paper (from the photographic dark room), and scatter a dozen radish seeds over the black paper. Moisten, but do not flood with water. Cover dish. Incubate at room temperature for 48 hours and the germinating hypocotyls will show a profusion of root hairs.

Small Display or Storage Bottles

Discarded penicillin bottles make excellent containers for a variety of stains, dyes, or chemicals and can be used for displaying collections of weed seeds, or any other small specimens in the biology laboratory. These handy bottles can be obtained from hospitals through the cooperation of some friendly nurse or from some doctor friend. It is only necessary to remove the aluminum band and cap, wash, rinse, and dry, and then put in use. Cork or rubber stoppers to fit are available in most chemistry supply cupboards or the original stopper may be used for some things. Likewise, the tiny glass bottles in which insulin is sold can be put to use in the laboratory.

Donald S. Lacroix,
Amherst High School,
Amherst, Massachusetts

The Use of Biography in Teaching Biology

ALAN WAYNE
Rhodes School, New York City

Human beings are naturally the most interesting of living things, and from the student's point of view the study of biology comes alive when biographical material is effectively introduced.

The writer's experience in a large private high school has convinced him that, if properly organized, the correlation of facts, generalizations, and experiments with the pertinent life experiences of biologists has many values and can be made with little extra expenditure of time.

From the teacher's point of view, the use of such material solves the main problem of motivation, through its approach on the basis of human interest. The dramatization of discovery satisfies the ever-present urge to go behind the scenes of life. For example, the evidence against the theory of spontaneous generation may be vitalized as a series of conflicts: that of Redi against common opinion; of Spallanzani against Needham; and of Pasteur against Pouchet. Again, the theory of immunity may be given reality through the controversy of Ehrlich and Metchnikoff.

Another important set of values realized through the use of biographical material are the scientific attitudes, such as detailed in the first part of the thirty-first yearbook of the NATIONAL SOCIETY FOR THE STUDY OF EDUCATION. These attitudes cannot be abstractly inculcated, but a sufficiently heroic model will always tend to arouse emulation, whether it be of Leeuwenhoek's accuracy of observation and description, of Darwin's patience, self-criticism and cooperative spirit, or of Noguchi's service to humanity.

The biographical approach is valuable, also, in providing ample opportunity for student activity in the form of not too technical readings and class reports, with their incidental training in independent research and self-expression. For this purpose a school or class biology library is essential, and the bibliography which follows suggests the nucleus of such a library.

BIBLIOGRAPHY

1. CLENDENING, L. *The Human Body.* Knopf.
2. COOTLER AND JAFFE. *Heroes of Science.* Little, Brown.
3. DE KRUIF, P. H. *Microbe Hunters.* Harcourt, Brace.
4. DE KRUIF, P. H. *Hunger Fighters.* Harcourt, Brace.
5. DE KRUIF, P. H. *The Fight for Life.* Harcourt, Brace.
6. DOBELL, C. *Anthony van Leeuwenhoek and His Little Animals.* Harcourt, Brace.
7. ECKSTEIN, G. *Noguchi.* Harpers.
8. FURNAS, C. C. AND S. M. *Man, Bread and Destiny.* Reynal.
9. GINZBURG, B. *The Adventure of Science.* Tudor.
10. HAGGARD, H. W. *Devils, Drugs and Doctors.* Harpers.
11. HOLMES, J. T. *Louis Pasteur.* Harcourt, Brace.
12. ILTES, H. *Life of Mendel.* Norton.
13. LOCY, W. A. *Biology and Its Makers.* Holt.
14. LOCY, W. A. *The Growth of Biology.* Holt.
15. WARD, C. H. *Charles Darwin.* Bobbs-Merrill.
16. WILLIAMS-ELLIS. *Men Who Found Out.* Coward-McCann.
17. WILSON, G. *Great Men of Science.* Garden City.

Objectives in the Teaching of Biology*

MARGARET McKIBBEN
University of Pittsburgh, Pittsburgh, Pennsylvania†

Every high school teacher realizes the importance of the use of objectives in giving purpose and organization to the study of living things. Yet an analysis of the aims as set forth in high school textbooks and educational literature yields only confusion because of the number and variety of objectives attached to the teaching of biology. Moreover, a casual survey of the objectives in force from the time of the introduction of biology into the curriculum of the secondary schools to the present day reveals that major changes have taken place in that field.

The following questions inevitably arise in the mind of the teacher: "Are all of these aims educationally sound?" and "Which, since instruction time is limited, should have precedence over others on account of their greater teaching value?"

This article is a condensed report of a survey of the objectives expressed and implied in available high school biology textbooks, laboratory manuals, and courses of study, in professional texts and periodicals, and in reports of investigations. It covers the period 1936 to 1945.

Although an analysis of some one hundred and fifty sources was made for the study, many were rejected on the basis that they were not on the secondary school level, that they were not concerned with biology for general education, and that they were not published in the United States between 1936 and 1945. It was assumed that the opinions of recognized authorities furnish authoritarian proof of the value of the objectives and, further, that the relative value of these objectives in the eyes of the authorities can be said to vary directly as the frequency of their appearance in such literature.

Method

All statements of objectives from a source were transferred to a card which indicated the author and title of the article or book. Each source was treated in this manner. An analysis of the cards thus prepared indicated that most of the statements secured could be classified under one or more of the following general objectives:

the scientific method
the scientific attitude knowledge
interest
social adjustment
economic values
avocational direction
vocational direction
preparation for future work and study
health
aesthetic values
character development

There was also a final category which can be called general application because it includes those indefinite statements concerning the application of biology to life problems of any sort whatsoever. The objectives on each card were then marked with a number to indicate to which objective group they belonged.

* This article is based upon a thesis written in partial fulfillment of the requirements for the degree of Master of Science in the biology department of the University of Pittsburgh, June 1946.

† The author is now teaching at Old Trail School, Akron 7, Ohio.

Conclusions

These general categories of objectives are obviously of two types. The first four, those dealing with the scientific method, the scientific attitude, knowledge, and interest, contribute to those other objectives dealing with social adjustment, the use of leisure time, and so on, which are desirable life outcomes. The first four can be called *intellectual* objectives; the rest, *practical* objectives. In the opinion of a majority of the authorities the intellectual objectives, less frequently mentioned in recent years, were not aims in themselves but only a means to the fulfillment of the practical objectives. Consequently it is with these practical life outcomes that we are concerned.

Based on these data and in accordance with the assumptions stated above we may conclude that the prevailing current objectives in guiding learning in biology are in order of descending importance; economic value, general application to life problems, health, social adjustment, avocational direction, aesthetic appreciation, vocational direction, and preparation for future work and study. Character training was not mentioned as an objective in this period.

The general application of biology to life problems of all types has been mentioned in the literature with increasing regularity, because of a growing realization that there is no other subject in the curriculum which touches upon man's affairs at so many points and which has within its scope the solution of so many problems which perplex us. That biology is becoming a required subject of the tenth grade curriculum in more and more schools is indicative in itself of the value of biology to pupils in the opinion of school administrators. The statement that education ". . . should help the student to do better the things that he will do anyway . . . ," stressing practical application, has been made so often that it is difficult to trace its origin.

In keeping with the preceding ideas the results of the present study indicate that practicality should be the general goal of the teaching of biology for general education. This means that in actual practice only those units and lessons should be taught which will function in the everyday life of the pupil and, keeping in mind the presence of individual differences, taught so that these blocks of subject matter will have the maximum value for each individual.

THE BOSTON MEETING

The first day of the two-day convention was taken up by business meetings of the Executive Board, Editorial Board, Representative Assembly and various standing committees. As in all such meetings a considerable part of the time was occupied by necessary routine business, but a few items are worthy of special note. The various officers' reports were encouraging on matters of membership, budget, publications and the like but all agreed that an increase in membership would greatly extend the usefulness and flexibility of the Association activities.

The affiliation with The American Nature Study Society, which had been under consideration since the St. Louis meeting, was completed. One of the interesting developments growing out of this affiliation is that The American Nature Study Society and The National Association of Biology Teachers will share responsibility for the monthly page in *Nature* magazine. Details of this arrangement will be explained in a future issue. President Palmer will assume editorial responsibility for tthe NABT portion of it.

The amendment proposed in the October issue was passed unanimously. The effect of this amendment is to make the chairmen of state and regional membership committees members of the representative assembly.

The exhibits prepared by The American Nature Study Society and by a group of high school students under the direction of Irving Keene were attended and much appreciated not only by members of our own organization but by many attending other meetings in the Bradford Hotel.

The two program sessions under the direction of President Palmer were well-attended and well-received. The idea of a program built around a central theme was highly satisfactory and it was the general consensus of the group that it should be so arranged.

Some of the papers will be printed in full in forthcoming issues of *The American Biology Teacher* and others will be summarized or printed in digest form.

The banquet meeting was a stimulating and enthusiastic climax for the convention. Paul Sears' fine address on "Human Ecology" was at the same time highly instructional and entertaining. His well known ability to present difficult concepts by means of simple analogies was displayed at its best.

Books

POUGH, RICHARD H., *Audubon Bird Guide, Eastern Land Birds*, Doubleday & Co. Inc., Garden City, N. Y., 312 pp., illustrated, 1946. $3.00.

Excellent writing style and accurate color illustrations are combined in this descriptive manual of the eastern land birds (not including the hawk, grouse and dove families). After a brief foreword dealing with bird study in general and field study particularly, the book plunges at once without any keys into species descriptions. These are organized into identification, habits, voice, nest, and range. Subspecies are not included but mention of geographical races is made in a few instances, as for example, the song sparrow. Readers in the western part of the area will welcome the inclusion of both descriptions and illustrations of such species as the road runner, rock wren, mountain bluebird, hooded oriole and a number of others which regularly enter the "eastern" bird area but are not usually included in the descriptive lists of eastern birds. The use of English names has been simplified by the omission of subspecies. Names in widespread use are listed in the index with the reference to the standard English name. The middle section of the book consists of 48 pages of color plates with more than 400 pictures illustrating the various plumages of 275 species of birds included. The classified bibliography is more complete than is usual in books of this sort, but strangely does not include Chapman's *Birds of Eastern North America* or *Color Key to North American Birds*. There is a well-organized index with all technical names in italics and with the birds listed both by genus and by species. For either leisurely browsing or for actual field study, this book should be available to biology teachers and pupils and to bird enthusiasts throughout the area covered.

JOHN BREUKELMAN

DEWICK, ERNEST; COOPER, JOHN H., *Plastic Craft*. MacMillan. 179 pp. 1946. $5.00.

Plastic Craft is the latest edition of a book dealing with that rapidly expanding and ever popular field of plastics. Seldom has this reviewer's interest and curiosity been so aroused about a book. It may be predicted that the first printing will be quickly exhausted. This work combines the talents of a practical shop instructor and a trained artist. Complete information and specific directions are presented in non-technical language for the construction of over seventy objects, both useful and decorative, which can be made from plastics with relatively few and simple tools. The book is well adapted for self-study or use in any science course. Excellent line drawings and photographs illustrate every phase of the projects and clarify the discussion.

The book is divided into three sections, followed by adequate appendixes. *Part I* deals with the composition and uses of seven common plastics; good and poor design; color etching; tempera painting, and oil painting on plastics. *Part II* is concerned with project operations and includes the folllowing; plastic stock layouts, sawing, filing, drilling, threading and topping, sanding, turning, grooving, routing and shaping, planing, cleaning, ashing, polishing and buffing, cementing, heating, bending, embossing, engraving and carving, forming, fastening devices, joints, pressure methods, inlaying, jigs and fixtures, dip-dying, and heat cabinet construction. *Part III* describes the objects which can be made with plastics. Every step of every project is presented by both detailed directions and line drawing illustrations. A limited number of the projects will

be mentioned. They include: lamp variations, vases, trays, one-piece desk files, shelves, bulletin board, waterproof utility articles, picture frames, book ends, pocket memo, and desk calendar. This book is not intended primarily for biologists. However, it offers such a wide range for handicraft that it may well serve the interests and needs of any science group.

LEE R. YOTHERS

RECENT GOVERNMENT PUBLICATIONS

Malaria, Lessons on Its Cause and Prevention, for Use in Schools, by Carter, H. R. and revised by Williams, L. L. (Public Health Reports Supplement No. 18) 23 p., 1943. Government Printing Office, 10¢. Catalog No. FS2.8: 18.

Facts about malaria presented in question and answer form. Covers the cause, infection, identification of carriers, life history, symptoms, treatment, and control. Useful to science teachers at elementary and higher levels.

Photographic Set PH–261, War Department Technical Manual 11–400. 35 p., 1945 (formerly restricted). Government Printing Office, 15¢. Catalog No. W1.35: 11–400/2.

Reveals a complete photographic kit with instructions for use. Of special interest to members of a photography club and other photography fans.

Poison Ivy, Poison Oak, and Poison Sumac, By Crooks, Donald M. and Kephart, Leonard W. (Farmers Bulletin No. 1972, U.S.DA.) 30 p., revised 1946. Government Printing Office 10¢, Catalog No. A1.9: 1972/2.

Reveals the menace to health, the identification, and methods for eradication of these poisonous plants. Precautions against, and treatment for poisoning are also discussed. Suitable for general science and biology students and interesting to students of chemistry. Helpful to all science teachers.

How Science Teachers May Obtain Government Publications

PHILIP G. JOHNSON
Specialist for Science, Division of Secondary Education, U. S. Office of Education, Washington 25, D. C.

Many requests about the availability of government publications on a wide variety of topics are received in the United States Office of Education. The teachers who make the requests have an idea that there may be a bulletin available for their desired item of information. They do not know where to locate or secure it. In many cases, teachers are correct in thinking that authoritative information is available. It may be possible for them to secure what they want and, in addition, many other publications which can be of help to them and to their students.

A. How to Discover What Is Available:

Check the available Price Lists to indicate the ones you desire. A copy of a recently released one is on page 124. Tear out this page and mail it, properly filled out with your name and address, to the Superintendent of Documents, Government Printing Office, Washington 25, D. C. There is no charge for any of these lists.

B. How to Secure the Publications You Desire:

Use the order blank which you will receive with the Price Lists and order

the publications you desire. Enclose remittance as instructed. Your school librarian may be willing to do the ordering for you and pay for the publications from library funds. Your principal or superintendent may provide funds for this purpose. You may wish to develop your own library by paying the modest charges yourself. It is possible that a number of your students may wish to order some of the publications described in the Price Lists.

C. How to Keep in Touch with Selected New Releases:

Write a card or letter to the Superintendent of Documents and ask that your name be included among those who receive the semimonthly List of Selected United States Government Publications. This list announces twice a month a few of the new releases which are of general public interest. Annotations and prices are included. There is no charge for this leaflet.

D. How to Keep Informed About All New Releases:

Arrange for a subscription to the Monthly Catalog of United States Government Publications. The school librarian may obtain this catalog for use by all school employees or you may become a personal subscriber. This catalog is issued by the Superintendent of Documents at $2.25 a year domestic delivery and $2.85 per year foreign. This catalog lists the publications of all departments issued during each month, whether for sale or otherwise, quoting prices in all instances where the publication is for sale.

Here are a few examples of publications which were selected from several of the lists of publications and currently available from the Superintendent of Documents, Government Printing Office, Washington 25, D. C.:

History of Water Witching, with Bibliography. 1938. 59 p. (Geological Survey, Water-Supply, Paper 416) 15¢.

Cancer posters (1941). Each 28 × 22 inches, 4 different posters at 5¢ each. (Public Health Service.)

International Metric System (chart). 28.1 × 44.1 inches. (Standards Miscellaneous Publication 3) 40¢.

A General Account of the Development of Methods of Using Atomic Energy for Military Purposes Under the Auspices of the United States Government. 1940–45. By H. D. Smythe. 35¢.

Science, the Endless Frontier. Report to the President on a Program for Post-war Scientific Research. By Vannevar Bush. 30¢.

Story of Radar by John M. Hightower (1943). 19 p. (78th Congress, 1st Session; S doc. 89) 10¢.

Radar—A Report on Science at War. 15¢.

Several divisions of the government issue separate lists of publications. Many of these publications are available free until the free supply is exhausted. Some publications are for sale only. If teachers have a special interest in the publications of any one division, they may wish to write directly to that division asking that the list of available publications and the monthly lists of new releases be sent to them.

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M. A. RUSSELL, Sec'y-Treas.,
403 California Avenue,
Royal Oak, Michigan.

Price Lists

GOVERNMENT PUBLICATIONS

These price lists are issued by the Superintendent of Documents, Government Printing Office, Washington 25, D. C. They describe each available book or pamphlet, and embrace current topics as follows:

☐ **10 Laws.** Federal statutes and compilations of laws on various subjects.

☐ **11 Foods and Cooking.** Home economics, household recipes, canning, cold storage.

☐ **15 Geological Survey.** Covers geology and water supply.

☐ **18 Engineering and Surveying.** Leveling, tides, magnetism, triangulation, and earthquakes.

☐ **19 Army and Militia.** National defense, veterans' affairs.

☐ **20 Public Domain.** Public lands, conservation, National Resources Planning Board.

☐ **21 Fish and Wildlife Service,** and other publications relating to fish and wildlife.

☐ **24 Indians.** Publications pertaining to Indians, anthropology, and archeology.

☐ **25 Transportation and Panama Canal.** Railroad and shipping problems, postal service, communications, Coast Guard, Panama Canal.

☐ **28 Finance.** Banking, securities, loans.

☐ **United States Office of Education,** and other publications relating to education.

☐ **32 Insular Possessions.** (Philippines, Puerto Rico, Guam, American Samoa, Virgin Islands.)

☐ **33 Labor.** Child labor, women workers, wages, workmen's insurance and compensation.

☐ **35 Geography and Explorations.** National parks, guidebooks.

☐ **36 Government Periodicals,** for which subscriptions are taken.

☐ **37 Tariff.** Compilation of acts, decisions, and regulations, relating to tariff, taxation, and income tax.

☐ **38 Animal Industry.** Domestic animals, poultry and dairy industries.

☐ **41 Insects.** Bees and honey, and insects harmful to man, animals, and plants.

☐ **42 Irrigation, Drainage, Water Power.** Federal Power Commission, water resources.

☐ **43 Forestry.** National forests, ranges, lumber and timber, American woods.

☐ **44 Plants.** Culture of fruits, vegetables, cereals, grasses, grain.

☐ **45 Roads.** Construction, improvement, and maintenance.

☐ **46 Agricultural Chemistry and Soils and Fertilizers.** Chemistry of foods, soil surveys, soil erosion, and conservation.

☐ **48 Weather, Astronomy, and Meteorology.** Climate, floods, aerological observations.

☐ **49 Proceedings of Congress.** Bound volumes of Congressional Record and Congressional Globe.

☐ **50 American History and Biography.** The Revolution, Civil War, World War.

☐ **51 Health.** Diseases, drugs, sanitation, water pollution.

☐ **53 Maps.** Government maps, and directions for obtaining them.

☐ **54 Political Science.** Government, crime, liquors, District of Columbia, Supreme Court, un-American activities.

☐ **55 National Museum.** Contributions from National Herbarium, National Academy of Sciences, and Smithsonian reports.

☐ **58 Mines.** Explosives, fuel, gas, gasoline, petroleum, minerals.

☐ **59 Interstate Commerce.** Steam railways, motor carriers, carriers by water.

☐ **60 Alaska and Hawaii.** Mineral and agricultural resources, coal lands, geology, water supply, seal fisheries.

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☐ **63 Navy.** Publications relating to Navy and Marine Corps.

☐ **64 Standards of Weight and Measure.** Tests of metals, building materials, electricity, photography.

☐ **65 Foreign Relations.** Executive agreements, treaties, neutrality, international conferences.

☐ **67 Immigration.** Aliens, citizenship, naturalization, races.

☐ **68 Farm Management.** Agricultural credit, farm products, marketing, agricultural statistics.

☐ **69 Pacific States:** California, Oregon, Washington. All material relating to these States.

☐ **70 Census.** Statistics of population, manufactures, agriculture, occupations.

☐ **71 Children's Bureau,** and other publications relating to children.

☐ **72 Suburbanites.** Publications of interest to suburbanites and home builders.

☐ **75 Federal Specifications.** Federal standard stock catalog.

☐ **77 World War II.** National defense, postwar planning.

☐ **List of Field Manuals and Technical Manuals.**

☐ **List of Radio Publications.**

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